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WAGNER MURABITO & HAO
THIRD FLOOR
TWO NORTH MARKET STREET
SAN JOSE CA 95113
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EXAMINER
PADMANABHAN, M

ART UNIT	PAPER NUMBER
2772	2

DATE MAILED: 03/19/99

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

	Application No.	Applicant(s)
Office Action Summary	08/845526	Christian Pappas Henry Moreton Robert Williamson
	Examiner	Group Art Unit
	Mano Padmanabhan	2772

☒ Responsive to communication(s) filed on ___4/25/97___.

☐ This action is **FINAL**.

☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire _____ month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

☒ Claim(s) ___1-25___ is/are pending in the application.

    Of the above, claim(s) _____ is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) ___1-25___ is/are rejected.

☒ Claim(s) ___8___ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☒ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

    ☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been

        ☐ received.

        ☐ received in Application No. (Series Code/Serial Number) _____ .

        ☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

    *Certified copies not received: _____ .

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☒ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☐ Interview Summary, PTO-413

☒ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- *SEE OFFICE ACTION ON THE FOLLOWING PAGES* ---

DETAILED ACTION

Claim Objections

Claim 8 is objected to because of the following informalities: the line "rendering the

curve or surface with the graphics rendering pipeline" appears in 2 consecutive lines of this

claim, and seems to be a typographical error . Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the

basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claim 16 is rejected under 35 U.S.C. 102(b) as being clearly anticipated by Luken, Jr.

(U.S. Patent Number 5,278,948).

Claim 16 lays claim to a method of generating normal vectors for a surface based on

generating surface partials, then generating surface tangents from these partials, and generating

normals from these tangents.

Luken teaches a method of generating surface partials, generating tangents, and surface

normals (Col.9: lines 6-24).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in
> section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are
> such that the subject matter as a whole would have been obvious at the time the invention was made to a person
> having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the
> manner in which the invention was made.

Claims 1-3, 6, 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Jia et al.*

(U.S. Patent Number 5,726,896) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684).

Claim 1 lays claim to a computer system that implements the method of receiving a

NURBS model from a server, converting it to a Bezier model, generate a plurality of control

points on the Bezier curve, and rendering the curve using the graphics pipeline.

Jia et al teach a method of converting a NURBS surface model to a Bezier surface model

(Col. 4: lines 38-45), and interpolates a plurality of control points (Col. 5: lines 1-5). *Jia et al*

fail to teach a method to receive the data from the server (host processor) and rendering it.

Gharachorloo et al teach a method to receive data from a host processor into a graphics pipeline,

and use the graphics pipeline to render the object (refer Figs. 1, 2, 2A). Hence it would be

obvious to one skilled in the art at the time the invention was made to store the surface model

data in a host processor, and use this method to download the data as needed, and use the method

taught by *Jia et al* to display the object, as this would ensure better utilization of system

processing resources on the client machine.

        Claim 2 adds to claim 1 the step of receiving the NURBS surface model via the bus.

        Gharachorloo et al teach a method to receive data using a bus (refer Fig. 1).   Hence it

would be obvious to one skilled in the art at the time the invention was made to use a bus to

receive the NURBS model from a host processor, as it is an effective and dependable

communication medium.

        Claim 3 adds to claim 1 the step of generating multiple Bezier control points from

corresponding NURBS control points.

        Jia et al teach a method of converting from the general NURBS representation of a curve

to a Bezier representation of the same order. This teaches by implication that the two models

have the same number of control points.

        Claim 6 adds to claim 1 the limitation of generating points on the curve using Bezier

control points.

Jia et al disclose the use of Bezier control points as input to the processor that determines

points on the curve (Col.3: lines 32-44).

Claim 8 adds to claim 1 the use of graphics rendering pipeline to render the curve or

surface.

Claim 8 is assumed to read "The method of claim 1 further including the steps of:

processing the plurality of points with the graphics rendering pipeline; and rendering the curve or

surface with the graphics rendering pipeline". Gharachorloo teaches the use of a Graphics

pipeline (Fig. 1). Hence it would be obvious to one skilled in the art at the time the invention

was made to use a graphics pipeline to render the curve as this would streamline the process, and

accelerate the process of rendering the curve.

Claims 4-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Jia et al.*

(U.S. Patent Number 5,726,896) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684)

as applied to claim 3, and further in view of Schulmeiss (U.S. Patent Number 5,717,847) and

Luken, Jr. (U.S. Patent Number 5,278,948).

Claim 4 adds to claim 3 the use of tri-linear interpolator to generate the Bezier control

points.

Claim 5 adds to claim 4 the limitation of the use of NURBS control points as input to the

tri-linear interpolator, and evaluating these points to generate Bezier control points.

Jia teaches the method of evaluating a plurality of NURBS control points into Bezier

control points (Col.4: lines 38-44). Jia fails to teach the use of tri-linear interpolator, and the

input of NURBS control points to the tri-linear interpolator. Luken inherently teaches the use of

tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation

between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45),

the NURBS control points forming the input to these interpolators. Schulmeiss discloses the use

of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Hence it is

obvious to one skilled in the art at the time the invention was made to use a tri-linear interpolator

to generate the Bezier control points since this will provide high speed and accuracy.

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Jia et al.* (U.S.

Patent Number 5,726,896) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684) as

applied to claim 6, and further in view of Luken, Jr. (U.S. Patent Number 5,278,948) and

Sherman et al (U.S. Patent Number 5,734,756).

Claim 7 adds to claim 6 the limitation that the Bezier control points are input to a tri-

linear interpolator to generate points on the curve.

Jia et al disclose the use of Bezier control points as input to the processor that determines

points on the curve (Col.3: lines 32-44). Jia et al also teach that the Bezier curve is a special case

of the B-spline curve (Col.7: line 27). Jia et al fail to disclose the use of tri-linear interpolator.

Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau

process performs a linear interpolation between the components (x,y,z) of the control points

(Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these

interpolators. Sherman et al teach that Bezier curves are generally evaluated using a recursive

algorithm due to de Casteljau (Col.14: lines 32-35). Since Bezier curve is a special case of a

NURBS curve, it would be obvious to one skilled in the art at the time the invention was made to

input the Bezier control points to a tri-linear interpolator to generate points on the curve, as this

would improve system performance.

Claims 9-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Luken, Jr.*

(U.S. Patent Number 5,278,948), *in view of Jia et al.* (U.S. Patent Number 5,726,896) and

Sherman et al (U.S. Patent Number 5,734,756).

Claim 9 lays claim to a method of rendering curves by evaluating a Bezier curve using de

Casteljau process in the graphics rendering pipeline.

Luken teaches the use of Cox-DeBoor (or DeCasteljau) process for evaluating a b-spline

curve (Col.15: lines 40-44). Luken also teaches the method of using a graphics pipeline (Col.28:

lines 59-61), and the use of Cox-DeBoor process in the graphics processor for evaluation

(Col.29: lines 5-10). Luken fails to teach the use of these methods for a Bezier curve. Jia et al

also teach that the Bezier curve is a special case of the B-spline curve (Col.7: line 27). Sherman

discloses that the de Casteljau process is a widely accepted method of evaluating Bezier curves

(Col. 14: lines 32-35). Hence it would be obvious to one skilled in the art at the time the invention was made to use the de Casteljau process in the graphics pipeline to evaluate a Bezier curve to render the curve, as this method was well tested and widely known in the art.

Claim 10 adds to claim 9 the limitation that the de Casteljau process is implemented using a tri-linear interpolator.

Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators.

Claim 11 adds to claim 9 the limitation that the Bezier control points are input to a tri-linear interpolator to generate points on the curve.

Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Luken fails to disclose the use of Bezier control points as input to these interpolator. Jia discloses the use of Bezier control points as input to the processor that determines points on the curve (Col.3: lines 32-44). Jia also teaches that the Bezier curve is a special case of the B-spline curve (Col.7: line 27). Sherman et al teach that Bezier curves are

generally evaluated using a recursive algorithm due to de Casteljau (Col.14: lines 32-35). Since

Bezier curve is a special case of a NURBS curve, it would be obvious to one skilled in the art at

the time the invention was made to input the Bezier control points to a tri-linear interpolator to

generate points on the curve, as this would improve system performance.

Claim 12 adds to claim 11 the limitation of using the plurality of points to render the

Bezier curve.

Luken discloses a method of using the points derived by evaluating a b-spline to render a

surface (Col.27: lines 11-21). Since Bezier is a special case of a B-spline curve (Jia: Col. 7: line

27), it would be obvious to one skilled in the art at the time the invention was made to use of

Bezier control points during evaluation to render a Bezier curve, as this would involve the least

amount of operations on the part of the graphics processor.

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Jia et al.* (U.S.

Patent Number 5,726,896) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684).

Claim 13 lays claim to a graphics rendering pipeline of a computer system that evaluates

the NURBS control points to a Bezier model, generate a plurality of control points on the Bezier

curve, and rendering the curve.

Jia et al teach a method of loading a processor with the NURBS control points (Col.3:

lines 32-36), converting the NURBS surface model to a Bezier surface model (Col. 4: lines 38-

48), and determining a plurality of points on the Bezier curve. *Jia et al* fail to teach a method of rendering the curve using a graphics pipeline. *Gharachorloo et al* teach a method of using the graphics pipeline to render NURBS surfaces (Col.9: lines 64-67). Hence it would be obvious to one skilled in the art at the time the invention was made to use a graphics pipeline to render the Bezier curve using the points derived by using the method as described by Jia, as this would streamline the rendering process, and ensure better utilization of system processing resources.

Claims 14-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Jia et al.* (U.S. Patent Number 5,726,896) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684) as applied to claim 13, and further in view of Schulmeiss (U.S. Patent Number 5,717,847) and Luken, Jr. (U.S. Patent Number 5,278,948).

Claim 14 adds to claim 13 the limitation of using a tri-linear interpolator to evaluate the NURBS control points into Bezier control points.

Jia teaches the method of evaluating a plurality of NURBS control points into Bezier control points. Jia fails to teach the use of tri-linear interpolator, and the input of NURBS control points to the tri-linear interpolator. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Hence it is obvious to one

skilled in the art at the time the invention was made to use a tri-linear interpolator to generate the

Bezier control points since this will provide high speed and accuracy.

Claim 15 adds to claim 13 the step of transforming the NURBS curve or surface from a

global domain to a local domain.

Gharachorloo teaches a method of transforming the NURBS surface model from a global

memory to local memory (Col.2: line 58 - Col.3: line 10 & Col.14: lines 17-27). Hence it is

obvious to one skilled in the art at the time the invention was made to use global to local

transformation of the NURBS curve, as such a transformation can make better utilization of the

available resources.

Claims 17-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr.

(U.S. Patent Number 5,278,948) as applied to claim 16, in view of *Jia et al.* (U.S. Patent

Number 5,726,896) and Schulmeiss (U.S. Patent Number 5,717,847).

Claim 17 adds to claim 16 the limitation of using a tri-linear interpolator to evaluate the

Bezier control points, and generate surface partials.

Luken inherently teaches the use of tri-linear interpolators by disclosing that the de

Casteljau process performs a linear interpolation between the components (x,y,z) of the control

points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to

these interpolators. Luken also teaches the use of interpolators for each component to derive the

surface partials (Col. 19: lines 18-25). Luken fails to teach the use of Bezier control points as input to the tri-linear interpolator. Jia teaches the method of evaluating Bezier control points (line 35-40). Jia also teaches that Bezier curve is a special case of a B-spline curve. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Hence it is obvious to one skilled in the art at the time the invention was made to use Bezier control points as input to a tri-linear interpolator to generate surface partials, since Bezier points are a subset of NURBS control points.

Claim 18 adds to claim 16 the step of generating the surface tangents from the surface partials using a blender in the graphics pipeline.

Luken teaches the generation of surface tangents from surface partials for NURBS surfaces (Col.9: lines 6-25). Luken fails to teach this for blending curves. Jia teaches that the Bezier curves are a special case of B-splines, and also teaches the use of Bezier curves as blending functions (Col. 7: lines 29-31). Hence it is obvious to one skilled in the art at the time the invention was made to use such blending curves, since the shape approximation with NURBS is not generally understood, and the NURBS can be exactly represented by a series of piecewise Bezier curves.

Claim 19 adds to claim 18 the step of generating at least one normal from the surface tangents.

Luken teaches the method of generating normals from surface tangents ((Col.9: lines 6-25).

Claims 20-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr. (U.S. Patent Number 5,728,948) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684).

Claim 20 lays claim to a method of rendering a curve by doing a global to local transformation, evaluating the NURBS control points, and rendering the curve using the points thus created.

Luken teaches a method of evaluating NURBS control points to derive points on the curve (Col.15: lines 40-45). Luken fails to teach a transformation from global domain to local domain. Gharachorloo teaches a method of transforming the NURBS surface model from a global memory to local memory (Col.2: line 58 - Col.3: line 10 & Col.14: lines 17-27), rendering a NURBS curve. Hence it would be obvious to one skilled in the art at the time the invention was made to use the transformation as taught by Gharachorloo so as to make better utilization of the local resources.

Claim 21 adds to claim 20 the step of indexing at least one look up table for performing the transformation.

Luken teaches the use of transformation matrix pre-loaded in memory in the graphics

control processor (Col.12: lines 18-20).

Claim 22 adds to claim 21 the limitation of evaluating the NURBS control points using

tri-linear interpolator.

Luken inherently teaches the use of tri-linear interpolators for evaluating the NURBS

control points, by disclosing that the de Casteljau process performs a linear interpolation between

the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45).

Claim 23 adds to claim 22 the limitation of indexing the look up table to be able to

configure the tri-linear interpolator.

Luken teaches the use of transformation matrix pre-loaded in memory in the graphics

control processor (Col.12: lines 15-20), which is used to transform the x, y, z coordinates of the

control points.

Claim 24 adds to claim 23 the step of implementing a quadri-linear interpolator using tri-

linear interpolator, and generating control points.

Luken discloses the existence of NURBS control points with coordinates (wx,wy,wz,w),

and the evaluation of such control points by interpolation (Col.15: lines 32-46). This inherently

teaches quadri-linear interpolation.

Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr. (U.S.

Patent Number 5,728,948) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684), and

further in view of Oha (U.S. Patent Number 5,202,670).

Claim 25 adds to claim 20 the use of convolution in the graphics pipeline to obtain points

on the curve.

Oha teaches the convolution of original data and interpolated function in the graphics

pipeline to derive a set of points on the curve (Col.15: lines 5-13). Hence it is obvious to one

skilled in the art at the time the invention was made to use convolution in order to achieve faster

processing of the control points.

Conclusion

Any response to this correspondence should be mailed to:

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"PROPOSED" or "DRAFT")

Hand-delivered responses should be brought to Crystal Park II, 2021 Crystal

Drive, Arlington. VA., Sixth Floor (Receptionist).

Any inquiry concerning this communication or earlier communications from the examiner

should be directed to Mano Padmanabhan whose telephone number is (703) 306-2903. She can

normally be reached Monday-Thursday from 6:30am-5:00pm.

If attempts to reach the examiner are unsuccessful, the examiner's supervisor, Mark Powell,

can be reached on (703) 305-9701.

Any inquiry of a general nature or relating to the status of this application should be directed

to the Group receptionist whose telephone number is (703) 305-3900.

MARK K. ZIMMERMAN
PRIMARY EXAMINER

MP

March 10, 1999